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Logistics Reachback

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This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

//signed//
MARK M. HOFFMAN
Deputy Chief
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The effort was focused on performing research to identify capabilities that could enhance the Air Force's ability to support forward deployed forces in contingency situations. As was discovered early in the course of the research, Reachback is many things to many people. During this effort it was discussed within the context of the definition stated in the Agile Combat Support Concept of Operations: "It is the concept whereby the Command in Chief's (CINC) staff and deployed units seek support from rear or Continental United States (CONUS)-based organizations. Deployed units transmit requests for support and status reports back to CONUS. The success of Reachback depends on seamless data flow from the forward location through the entire support pipeline." Deployed units will reach back, primarily to the CONUS, for the follow-on support necessary to conduct sustained operations. Whatever the weapon systems being supported, for Reachback to be successful, a common operating picture is necessary so that key people in the logistics system, particularly decision makers, have a complete integrated view of the total requirements including full visibility of assets wherever they are. To gather the data necessary to develop these high level requirements USAF operational commands and logistics centers, as well as the DLA aviation support center, were visited. Trips were conducted to HQ ACC, HQ AMC, HQ AFSOC, OO-ALC, OC-ALC, WR-ALC, and DSCR. The basic thrust was to learn from the operational command personnel what would be necessary for the warfighters to accomplish the day-to-day mission. With that basic information in hand, the logistics centers were then asked what capabilities would be needed to support the logistics needs of the warfighters.

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EXECUTIVE SUMMARY

The effort was focused on performing research to identify capabilities that could enhance the Air Force's ability to support forward deployed forces in contingency situations. As was discovered early in the course of the research, Reachback is many things to many people. During this effort it was discussed within the context of the definition stated in the Agile Combat Support Concept of Operations: "It is the concept whereby the CINC's staff and deployed units seek support from rear or CONUS-based organizations. Deployed units transmit requests for support and status reports back to CONUS. The success of Reachback depends on seamless data flow from the forward location through the entire support pipeline." Deployed units will reach back, primarily to the Continental United States (CONUS), for the follow-on support necessary to conduct sustained operations. Whatever the weapon systems being supported, for Reachback to be successful, a common operating picture is necessary so that key people in the logistics system, particularly decision makers, have a complete integrated view of the total requirements including full visibility of assets wherever they are. To gather the data necessary to develop these high level requirements USAF operational commands and logistics centers, as well as the DLA aviation support center, were visited. Trips were conducted to HQ ACC, HQ AMC, HQ AFSOC, OO-ALC, OC-ALC, WR-ALC, and DSCR. The basic thrust was to learn from the operational command personnel what would be necessary for the warfighters to accomplish the day-to-day mission. With that basic information in hand, the logistics centers were then asked what capabilities would be needed to support the logistics needs of the warfighters.

As the interviews progressed one message came through loud and clear---"Don't build yet another computer system, we already have enough, what we need is actionable information." What is needed in Reachback is a capability for a decision maker to have data automatically drawn from whatever system or systems it is in, combine that data into information the decision maker needs, and have it presented in a form which that person understands so that action can be taken or decisions can be made in a timely fashion.

It is one thing to identify problems and a list of required new logistics capabilities. It is quite another to find and recommend solutions that are available. The tools discussed in this report when used alone will contribute to improving mission support shortfalls but will appear to be the dreaded "another new system" approach that the logisticians do not want. However, when used together the tools will form the backbone of the required capabilities discussed in Section 3, Required Capabilities for Reachback. The

tools discussed are organized into these main areas: Reliable Logistics Communications, Asset Tracking, Total Asset Visibility, Serial Number Tracking, and Cougaar Technology.

The Air Force Portal may be of value where some communication node exists to tap into the portal. This could be either a hard-line communication capability or satellite connectivity. Satellite communication is available nearly worldwide, but until recently this too has had large drawbacks—among them, size and cost of the equipment. Some tremendous progress is being made however with the use of briefcase-sized communication packages. One Air Force program that has embraced the new technology is the Logistician's Contingency Assessment Tools (LOGCAT) program managed by the Standard Systems Group (SSG), Logistics Planning Systems Division (SSG/ILX), Maxwell AFB-Gunter Annex, Alabama. Their solution uses relatively small all-in-one case capability of rapidly set up and operated equipment that allows voice and visual connectivity between any locations in the world. To take maximum advantage of communications with a rear area, local communications must be available, but landline dependence has severe risk—landlines simply may not exist. To solve that, wireless communication devices must be used. Federal Express has initiated a system with Xybernaut Corporation that allows their technicians on the aircraft to communicate directly with people in other areas of the airfield. If this were coupled with satellite relay of the communication, the technician could then discuss problems with experts thousands of miles away and get a quick resolution to potentially mission impacting problems.

Tracking the location and security of assets in storage or enroute between locations is a long-standing problem. DLA has started a large automated asset tracking system within three of its major Defense Distribution Centers that could be mimicked on a smaller scale at any storage area. Once gathered, the information could be relayed anywhere desired. The US Army has a very ambitious contractual program with Savi Technology to provide shipment-tracking information on thousands of assets and containers automatically. The Army estimated that if an effective way of tracking the location and content of the containers had existed in the early days of Operation Desert Shield, the DoD would have saved roughly $2 billion. Savi Technology's systems will provide the Army with real-time data about their shipments including location and security.

The DoD and Air Force are exploring improvements in Automatic Identification Technologies. The DoD charge is for AIT to provide timely information with a minimum of human intervention. There are many systems being investigated by the services. Most of them are still stand-alone, but technology exists and it has been successfully demonstrated that data from many different systems can be linked to provide

commanders and logisticians with useful information rather than many pieces of data that overload the command and control senses.

Cougaar technology, developed in a DARPA funded project could well be the main driver behind successes in achieving advanced logistics information presentations. While Cougaar would first seem to be "another new system" that logisticians don't need or want, it is instead an architecture for construction of large-scale distributed agent-based applications that will then autonomously communicate with other software agents to achieve domain-specific functionality. It has been used with the Advanced Logistics Project and Ultra*Log to successfully operate groupings of over 200 agents running on 30 machines to develop complex military logistics plans in only a few hours versus days that would be required when direct human intervention is needed.

People don't need another system providing them more information. They need something that will work with the information already available, analyze the data for relationships, and present to the user alerts to do something, list possible solutions, and perhaps inform the user that some automated response has been made. Several available tools are discussed in this report. Much like a mechanic who frequently has two wrenches at a job site, one of which is too small and the other is too large, many of today's data systems either don't quite fit the job, or they are too large and cumbersome to use. Although the one magic solution to all the needs of the nations warfighters was not found, the beginnings of a solution are described in this report. By linking the many systems together and using the robust agent technology as background operation, users will have available to them all the information they will need, as they need it.

Trademarks

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1 INTRODUCTION

1.1 Scope

This effort was focused on performing research to identify capabilities that could enhance the Air Force's ability to support forward deployed forces in contingency situations. However, with the Air Expeditionary Force (AEF) concept under which the Air Force operates today, the differences in the processes used to support deployed forces in normal operations versus in a contingency are disappearing. Thus, it was determined at the very beginning of the effort that this research should focus on identifying requirements to support forces operating under the AEF concept, whether or not they are deployed in a contingency. Although present depot processes and capabilities that support the AEF were discussed during the research visits, this effort was primarily aimed at identifying new or improved requirements and capabilities. Although there is potential for some support to come from other than USAF sources, this research concentrated on the USAF logistics system since that is where the requirements will be identified, tracked, and satisfied (although, as noted below, one Defense Logistics Agency {DLA} visit was conducted). In addition, any substantive research into joint service or coalition logistics systems under this effort would have been cost prohibitive.

1.2 Reachback Definition

As was discovered early in the course of this research, Reachback is many things to many people. To ensure consistency in the research and to preclude becoming sidetracked in discussions of what Reachback really meant, whenever Reachback was discussed during this effort it was discussed within the context of the definition stated in the Agile Combat Support (ACS) Concept of Operations, para. 1-4:

> Reachback encompasses the complex network that transfers information regarding weapons systems status and requirements. It is the concept whereby the CINC's staff and deployed units seek support from rear or CONUS-based organizations. Deployed units transmit requests for support and status reports back to CONUS. The status reports provide the mechanism for prioritization of requests and order of replenishment. This process must be supported by information systems that ensure that the top priority requirements are automatically identified and delivered by the optimal transportation mode. The success of Reachback depends on seamless data flow from the forward location through the entire support pipeline. Reachback will make it possible to deploy fewer functions and personnel forward for the deployment and sustainment process.

1.3 Background

The Reachback Concept was introduced as a framework within which deployed forces will be supported. Under Reachback, AEF units deploy quickly with only the basic logistics support for those forces to initiate operations upon arrival. Deployed units will then reach back, primarily to the Continental United States (CONUS), for the follow-on support necessary to conduct sustained operations. To support long

term operations, especially combat operations, under the Reachback concept it is essential that the requirements of deployed forces be known in near real time and that an integrated logistics system be in place to fill them; again, in near real time. Ideally, the logistics system should know what those requirements are before they generate and have the required support in place or on the way by the time it is actually needed. Although the autonomic logistics system for the F-35 Joint Strike Fighter will include considerable Reachback capability, over half of the aircraft that will comprise the Air Force fifteen years hence are on the flightlines today. That fact could not be ignored in this research effort. The capabilities considered must support today's weapon systems as well as future ones, such as the F-35.

Whatever the weapon systems being supported, for Reachback to be successful, a common operating picture is necessary so that key people in the logistics system, particularly decision makers, have a complete integrated view of the total requirements including full visibility of assets wherever they are, such as in repair at a depot, awaiting parts in a base shop, on a pallet in an airborne airlift aircraft, in a unit's deployment kit, or being manufactured or repaired in a contractor facility. However, knowing the requirements and where the assets are to satisfy them is only part of this common operating picture. Another critical feature is an integrated view of the transportation system featuring options on how to get items where they are needed as quickly as possible. A necessary feature in this common operating picture is the capability to redirect enroute assets at any point in the transportation system. Such a common operating picture will give the warfighters and those tasked with supporting them information on which they can depend and will facilitate better decisions up and down the support chain. This capability is achievable, but some formidable technological challenges still remain.

1.4 Approach

The research was broken into two phases: 1) identification of the high level requirements for a Reachback environment, and 2) development of a limited concept demonstration of some potential Reachback capabilities. Due to the limited money and time available, it was decided to focus the high level requirements identification effort on determining what a logistics Reachback environment should generally look like. To gather the data necessary to develop these high level requirements USAF operational commands and logistics centers, as well as the DLA aviation support center, were visited. Trips were conducted to:

- HQ Air Combat Command (ACC)
- HQ Air Mobility Command (AMC)
- HQ Air Force Special Operations Command (AFSOC)

- Ogden Air Logistics Center (OO-ALC)
- Oklahoma City Air Logistics Center (OC-ALC)
- Warner Robins Air Logistics Center (WR-ALC)
- Defense Supply Center Richmond (DSCR)

During the visits arrangements were made to meet with as many of the senior leaders as possible to gain their insight. Because these people are the key logistics decision makers in their respective organizations and because many have been or soon will be in key positions in flying wings, their view of what would be required to make Reachback work was considered key to this research effort.

The basic thrust was to learn from the operational command personnel what would be necessary for the warfighters to accomplish the day-to-day mission. With that basic information in hand, the logistics centers were then asked what capabilities would be needed to support the logistics needs of the warfighters.

The personal interview approach was used during all the visits. Interview sessions typically lasted between 60 and 90 minutes, although several went longer than that and a few were shorter. Because the people interviewed were extremely busy, maximum effort was made to properly focus discussions so as not to waste time. To do so, sets of basic questions tailored to either the operational commands or to the logistics centers were used. A "read ahead" document briefly describing the Reachback concept and this research effort was also sent to each person in advance of the visit to allow them to prepare for the interview. See Appendix B, Logistics Reachback – Read Ahead.doc.

2 BASIC ELEMENTS OF REACHBACK

During the research visits, a common theme became evident at operational commands and logistics centers. That theme centered on the need for some basic elements to be present in any Reachback environment that would eventually be developed. Those basic elements were:

- Common Operating Picture
- Total Asset Visibility
- Proactive Decision Support
- Active Collaboration

As the interviews progressed one message came through loud and clear as well---"Don't build yet another computer system, we already have enough, what we need is actionable information." This sentiment was expressed in one form or another by the overwhelming majority of those interviewed both at the operational commands and in the logistics centers.

Essentially it came down to a widely held view that there is plenty of data out there in the various logistics systems. However, there is also a widespread view that most of those systems are difficult to access and use and even when data is finally retrieved it still requires considerable manipulation and interpretation before it is useful to decision makers. The nearly unanimous position was that if Reachback is to be successful this issue must be overcome. What is needed in Reachback is a capability for a decision maker to have data automatically drawn from whatever system or systems it is in, combine that data into information the decision maker needs, and have it presented in a form which that person understands so that action can be taken or decisions can be made in a timely fashion. This whole process should happen in near real time.

2.1 Common Operating Picture

The most vital element in any Reachback environment is the common operating picture. Simply stated, the common operating picture is a single integrated view of the logistics situation. The view must provide a common source of information up and down the supply chain to eliminate confusion, misinformation, and lost decision time caused by duplicative (and often conflicting) data sources decision makers have to deal with today.

The common operating picture will use data from a variety of systems and will fuse various data elements from whatever source into actionable information. That information will be tailored to the specific needs of the individual decision maker and will be presented in a format established by the user. Information may also be pushed to the user based on business rules established by that user. Not only will the business rules be established by the user, but they will be easily modifiable on the spot, as the user's needs change. Automated alerts, triggered by business rules again established by the individual user, will be a key functionality within the common operating picture.

This research indicated that elements of a common operating picture, such as some of the work being done for the Air Force Portal, already exist or are under development; however, considerable work remains to be done. For example, significant human interface challenges still must be solved to ensure that the common operating picture provides a dynamic, integrated view. In addition, there are major technical and human factors challenges to be overcome to ensure that users from flightline production superintendents, to depot repair shop supervisors, to MAJCOM senior logistics leaders, and everyone in between, have access to the information they need, when they need it, and in a format they understand. Finally, this must be accomplished without subjecting the user to a "data overload – information starved" situation that many believe is an increasing problem today.

2.2 Total Asset Visibility

Total Asset Visibility (TAV), or rather the lack of it, has been a recognized problem in USAF logistics for a long time. Two-Level Maintenance and other Lean Logistics initiatives have resulted in far smaller stocks of nearly everything than was previously the case. The smaller levels, coupled with increasing operations tempo and aging weapon systems, have markedly increased the impact of not having that visibility. Considerable effort is going into working this problem and there have been some notable improvements, especially where the Regional Supply Squadrons (RSSs) are involved. Nonetheless, it is still often difficult for a depot repair shop or a deployed crew chief to get basic information about something they need, such as, "Is one available?" "Where is it? "When can I get it?" Answers to these questions must be provided in a timely manner. During this research it was frequently noted that, due to mission necessities requiring people to move out quickly and get something done (such as a cannibalization or other maintenance action), decisions were often sub-optimized because the information available to the decision maker regarding the parts or other assets they needed was either not current, was incomplete, was inaccurate, or was misunderstood.

Another facet of the TAV issue that this research showed to be increasingly important is the visibility of retrogrades. Retrogrades are the broken reparable parts that have been removed from a weapon system and must be sent to a repair center to be returned to service. Until rather recently, retrogrades received little attention. It was just assumed that they would eventually get back to the appropriate repair depot. In today's Lean Logistics environment, however, that retrograde is no longer just another broken item; it may very well be the next serviceable asset. Visibility of reparable assets as they move back to the depots from the flying units has become nearly as important as the mission capable (MICAP) parts flowing from the depots to the flying units.

2.3 Proactive Decision Support

The need for proactive decision support was frequently mentioned in the course of the research. Decision makers at all levels are busier today than ever before and they often have more to worry about than ever before. Given this situation it was generally agreed that a Reachback environment must provide some help in this area. Busy people, especially those in critical or key jobs, need all the help they can get to focus their attention for maximum payoff.

Most felt that Reachback should provide an "executive system" to help managers decide where they should be spending their time or what they should be doing first. Automated prompts should also be included to help predict and pinpoint impending problems—such as a contract that is about to expire, a critical level that is about to be breached, an inbound item that has been diverted, a contractor's scheduled production that is slipping, etc. In addition, potential options to solve the problem should be presented. The person could then choose one of the options or generate a solution of their own to address the situation.

To further assist decision makers in performing their duties, a "What if?" capability should be provided to allow managers the opportunity to assess the potential outcome of an action before actually taking that action. Thus, the likely consequences of a decision could be assessed to ensure the best outcome will be achieved before a decision is actually made. There is any number of examples of this capability such as:

- What are the likely results if I exercise one option vs. another?
- What if I spend my money here vs. there?
- What if I add additional dollars?
- What if I add three more spare widgets to the pipeline?
- What is the result if transportation time for a given part increases by two days?

Although feasible, this type of functionality has some significant human interface issues that will have to be satisfactorily addressed before it would be accepted and trusted by most people.

2.4 Active Collaboration

Today, units are deploying more frequently than in the past and they often go with fewer people and equipment than was the case during, for example, the months before the 1991 Gulf War. In addition, deployments to far more isolated and austere locations seem to be the order of the day. The name of the game in this Agile Combat Support/Lean Logistics world is to take as little forward as possible. Given this situation, it is increasingly likely that a deployed person in some out of the way location may be faced with a situation with which they have no experience, such as a particularly difficult or complicated maintenance problem.

To mitigate this potentially mission-limiting situation, Reachback should provide an active collaboration capability that would allow a mechanic faced with that daunting maintenance task to reach back for immediate help. Using a pocket-sized secure wireless device, the deployed mechanic could, for example, "show" the problem in real-time video to a more experienced technician at another location, possibly even in the CONUS. The technician could then walk the deployed mechanic through a repair procedure just as if they were both under the wing of the aircraft. The same capability could enable depot engineers to see a problem first hand (as if from under a broken aircraft) and make a repair or disposition decision in consultation with deployed troops on the spot rather than having to wait days to go through a cumbersome AFTO Form 107 process.

The Reachback environment would thus allow forward deployed people to be as capable and effective as possible. Enabling deployed troops to potentially take advantage of the entire USAF "brain trust" in this fashion could be a significant force multiplier.

Some of the elements of active collaboration as described here are available now—witness the now common live television news reports from far-flung locations to our homes. However, there remain some major technological challenges (bandwidth and security to name just two) that will require additional research to overcome.

3 REQUIRED CAPABILITIES FOR REACHBACK

To put in place a credible Reachback environment encompassing the basic elements discussed above, the research clearly showed that a set of enabling capabilities must first be achieved. Although some of those capabilities are separate and distinct, most are interrelated and overlap one another. Some will be difficult to achieve without others first being in place. However, it is conceivable that a capable, although less than optimum, Reachback environment might be achieved without all the enabling capabilities in place.

Although the order in which the capabilities are discussed below is by default a sort of prioritized listing, that priority might change somewhat depending upon who is discussing it. There was less than total agreement among those interviewed on the exact order of individual capabilities on the list, but no one disagreed that every one of those capabilities belonged on the list.

3.1 Reliable Logistics Communications

The one Reachback capability that everyone agreed on as the top priority was reliable logistics communications. Without this connectivity in place, just about everything else inherent in Reachback is mute. For a Reachback environment to be capable of immediately supporting deployed forces connectivity must be in place when those forces first arrive. In an Agile Combat Support/Lean Logistics environment the logistics system has to work right from the beginning. Because deployment kits are much smaller than in the past there will be no "spin up time." Resupply must start from day one to preclude mission impact.

The issue of logistics connectivity is a multi-faceted one. There is the question of convincing the theater commanders of the importance of dedicated logistics communications connectivity such that they will require that capability to be placed sufficiently early in the deployment flow. This research showed, however, that such a case has yet to be made. Right now, deployment flow is centered on "shooters" getting in first. In Operation Enduring Freedom (OEF), though, there were several instances of adverse mission impact because reliable logistics communications lagged the need. Indications are that these situations were largely forgotten about once the problem was solved (in all cases through "brute force" effort on the part of the logistics community) and nothing has changed. Thus, there is a significant probability that the same situation will recur.

Another facet of the logistics connectivity issue is exactly what communications are needed and how robust they should be. In the initial phases of OEF, for example, logistics people considered themselves

lucky if they even had access to a telephone in some locations. AFSOC forces, for example, go to a lot of places where others do not. Often there is no support structure or connectivity available at all. This has been a problem on nearly every recent deployment.

Those interviewed for this research agreed that there would always be a requirement for voice communication, probably secure voice communication. Beyond that, at a minimum, basic computer connectivity (such as a Standard Base Supply System {SBSS} hookup and the ability to communicate easily with a supporting Regional Supply Squadron {RSS}) is absolutely essential. In fact, it was generally agreed that Secure Internet Protocol Router Network (SIPRNET) access is going to be required very soon as concerns about operational security of forward deployed forces continues to mount. This, of course, will require SIPRNET access in the logistics centers since it is they who support the deployed warfighters. The position of HQ AFSOC today is that without SIPRNET their forces could not use the Reachback environment. Yet, Reachback needs to be accessible to whoever needs it wherever they are. If the information can only be displayed in a secure command post, then people will have to leave their job site (such as the flightline) to get access. This makes timeliness suspect and renders the system useless for practical purposes.

Although much of the technology to provide the logistics communication for Reachback is out there now, there are still some challenges to be overcome. Bandwidth, for example, is an increasingly significant problem. One can have all the capability in the world, but if everything bogs down, as is frequently the case at many OEF deployed sites, it quickly becomes useless. Video, for example, has major bandwidth requirements and soon clogs up most systems to the point that they are effectively shut down.

Wireless technologies, although improving rapidly, still leave a lot to be desired for something as critical as Reachback. Most wireless systems still have significant support infrastructures that would have to be deployed, installed, secured, and maintained. Right now there is a large radio frequency (RF) infrastructure that has to be put in place to enable wireless capability for F/A-22 support; however, there were big problems merely setting up an antenna that can even cover the Nellis AFB flightline. In addition, if one relies on RF they may find that it can't be used. In Japan, for example, the necessary frequencies are not available. There are similar problems in much of Europe as well.

Beyond the technological problems that still exist, there are also some significant human factors/human interface challenges that need to be addressed. Several issues require additional research such as how warfighters in austere conditions, such as flightlines at forward bases, can easily access and interface with

a Reachback environment at their job site; what type of device (personal data assistant {PDA}, pocket mini-computer, wearable device, etc.) will be best suited for people on flightlines and other such dispersed job sites; and how data will be displayed, input, and retrieved by forward deployed warfighters.

3.2 Reliable Transportation

One of the major outcomes of the Lean Logistics initiatives of the past several years was to clearly identify the fact that reliable transportation can be the difference between success and failure in today's logistics environment. This research certainly verified that. The subject came up in nearly every interview that was conducted.

During the 1990s there were several fundamental changes in Air Force logistics. One of the most significant was a shift in emphasis away from a supply-based logistics system that historically supported a "just-in-case" inventory concept with large stocks of repair parts at the bases and very robust spares kits for deployment support. Under ACS, logistics support is based on more of a "just-in-time" concept that is facilitated by express transportation and features much smaller spares inventories at the bases and far leaner deployment kits. Given these realities, a unit's combat capability now largely depends on timely, reliable transportation to get things, particularly aircraft parts, where and when they are needed.

Unfortunately, the research clearly showed that the transportation system has been unable to consistently meet expectations. The result is that confidence in the system has largely been lost. Thus, it is evident that the transportation system requires a major overhaul if Reachback is to be effectively supported over the long term. Although not unanimous, this opinion was widely held across all the organizations contacted during this effort. However, it should be noted that HQ AMC recognizes the problem and, with the help of their customers, is aggressively addressing this issue. Although a detailed study of the transportation system was beyond the scope of this effort, some areas where improvement is needed were noted.

One of the key transportation areas that must be addressed for Reachback to be effective is the priority system. There are significant disconnects between maintenance and supply priorities, and those in the transportation system. Likewise, there are inconsistencies between USAF priorities and those of the other services. As a result, it is often impossible for the system to identify the true priority items and earmark them for whatever special handling might be necessary to ensure that they move quickly and efficiently to their destination. "Horror stories" about items disappearing in the system, being misdirected, or merely failing to move with the proper sense of urgency were heard in every command and logistics center

visited in the course of this research. During OEF, the problem became so severe that both HQ ACC and HQ AMC positioned teams of expediters at Travis AFB and at Dover AFB for the sole purpose of finding their respective command's priority items that were not moving as they should and intervening to get those assets on their way to where they were needed.

To aid in rebuilding customer confidence, the transportation system must be able to accurately track individual items from origin to final destination. This is a vital ingredient of TAV, one of the essential elements of any viable Reachback environment. Under Reachback, decision makers and the warfighters they support should be able to "watch" an asset flow through the system, know its exact location, and when it will get to where it is needed. When it is not moving, they should see that too. Likewise, the decision makers, depending on their position and authority, should be alerted to the fact that something is not moving, what the problem is, and be presented with options for alleviating the situation. This should be true whether the item is a MICAP part on its way to a flying unit, a retrograde moving back to a depot, or a shop replaceable unit (SRU) needed to turn an asset serviceable destined for a repair shop.

Although there was some disagreement among those interviewed as to whether or not it should be a mandatory feature, there was a widely held view that Reachback should provide a capability to redirect assets within the transportation system, including those already enroute to a destination. In fact, it was noted that in an unusually critical situation there should actually be a capability to easily divert an airborne aircraft or a truck moving between destinations. This functionality should certainly be used sparingly and would no doubt require very high-level authority, but some felt that it should be available.

During this research, there was frequent mention made of efforts underway to address some of these issues. Certainly, much of the necessary technology is available; however, there is considerable additional logistics research needed to address the integration of various technologies and the human interface aspects of the potential solutions.

3.3 Solid Logistics Command and Control

Although few would minimize its importance under any circumstances, solid logistics command and control will be especially important in a Reachback environment. Due to the increasingly trying conditions with which deployed USAF units are faced, such as long supply lines, consistently high operations tempo, significant security concerns, and shortages of many assets, the need for good command and control has never been more important in logistics and that is likely to be the case far into

the future. Such things as who gets an item first, or who will not get one at all, take on a whole new significance for today's deployed forces.

Reachback must make it easy for decision makers throughout the logistics chain to know what the warfighters' needs are in real time. It is vitally important that those responsible for providing support be able to rapidly identify the real forward deployed requirement so it can be quickly met. For example, there must be visibility of everything for which an aircraft is MICAP, not just the pacing item as is the case now in the Core Automated Maintenance System (CAMS). Once a requirement is known, the Reachback environment must make it easy to source something and get it into the transportation system in real time.

There is also a pressing need for DLA to be "plugged into" the USAF systems. With that visibility they can react much faster to requirements for items they manage than is the case today. Along the same line, they need visibility of the next higher assemblies for those items to improve their ability to support warfighter needs. It was noted during the research that DLA frequently does not know of a USAF MICAP for several days. This has to change under Reachback.

Reachback must provide repair centers with visibility of retrogrades coming back for repair. Not only must they know what is coming and when it will arrive, they should know what the failure on the asset was so they can plan their production much better than is the case today. With solid information on the condition of an inbound item, shops might even be able to advance order repair parts they know are going to be needed so repairs can start much sooner after the retrograde arrives than is possible now.

With improved visibility of needed items, better decisions could be made up and down the supply chain. Depot shop managers who know through the Reachback environment that they can get the parts to fix an item coming in for repair can make better production decisions. Likewise, a technician in the field who knows if necessary SRUs are available will be able to make solid decisions on whether to merely send back a bad SRU or return the whole avionics box to the depot. Today lack of this kind of visibility makes the warfighters hesitate to turn in their reparables which sometimes causes them problems because that reparable they hoard is the very item the depot may need to generate their next serviceable asset.

Reachback must also provide repair center managers and other key decision makers the information they need to identify and rectify potential production constraints. Solid visibility of repair lines, whether

government or contractor, and their constraints can enable the system to know if one can depend on them producing what they are supposed to on schedule.

Again, much of the necessary technology to provide these functionalities is available. Systems such as Surge TRAK at WR-ALC, the Depot Repair Information Local Server (DRILS) at OO-ALC, and Exception Management Information that will be made available through the portal being developed at OC-ALC are only some of the examples of on-going efforts that could become elements of a future Reachback environment. However, additional research is necessary to specifically identify other such capabilities that may be out there. Not only will such an effort be valuable in determining what sources of essential Reachback information are available, it could also be quite valuable in identifying information voids that might require additional capability to be developed. Research is also necessary to quantify the potentially significant technical interface issues inherent in achieving a credible Reachback environment, as well as the human factors considerations that will surely impact the usefulness and ultimate acceptance of any Reachback environment.

3.4 Serial Number Tracking

Although potentially important in its own right, serial number tracking is a key enabler of much of the functionality that Reachback will require. Some items are serially tracked today, but they are a very small percentage of the total items out there. Simply stated, serial number tracking means that any reparable item such as an SRU, a Line Replaceable Unit (LRU) or other major component, a piece of test equipment, or an aerospace ground equipment (AGE) unit will have a unique serial number applied to it. Once so identified, individual SRUs, LRUs, or other major components, test equipment, and AGE items could then be specifically tracked and monitored to whatever level was deemed necessary.

There is little doubt that serial number tracking will be required to provide the level of visibility that the research indicates will be necessary in a viable Reachback environment. With serial number tracking in place, information could be accumulated rather quickly to help isolate bad actor parts. Likewise, it could provide the information necessary for repair centers to make solid decisions such as whether to just fix what is broke or completely overhaul an item.

There is little doubt that serial number tracking can be done Air Force-wide. The technology is there to make it relatively painless and the need for the information that could be gathered is increasingly clear. Implementation of it could, however, be relatively expensive. It would be a manpower intensive effort to place serial numbers on all the reparable items the Air Force owns, but that would only have to be done

once. There would also be some significant costs incurred to procure code readers and other devices necessary to support the program over the long term. However, these devices would be absolutely essential to make it easy for people to gather the information. Without those devices, the likelihood is that people will simply not be sufficiently motivated to consistently collect the data, thus rendering the program useless. Despite the expense involved, the case can be made to move forward with serial number tracking.

3.5 Pro-active Item Management

Most of those interviewed during this research effort, including the vast majority of those in the logistics centers, felt that item management must fundamentally change for Reachback to be totally effective. Today, due largely to the shear volume of work and the declining numbers and experience levels of both USAF and DLA item managers (IMs), most are in the react mode a significant portion of the time. As a result, there are numerous instances of assets slipping below critical levels or important repair contracts expiring without the IM realizing it in time to preclude problems. These situations have probably existed to some extent for a long time, but with much lower asset levels due to Lean Logistics initiatives over the past few years coupled with very high operations tempo through the same period, such occurrences have not only become more frequent but each instance has much more impact (and visibility) than was the case in the past. To be viable over the long term, Reachback must include automated enablers to not only help IMs identify impending problems in time to do something about them, but to present the IM with options to rectify the situation.

In addition, USAF and DLA interviewees were nearly unanimous about the need for far better requirements forecasting than is in use today. Even small increases in forecasting accuracy for critical and/or expensive items could provide major improvements in warfighter support. Much of the research in this area has already been done, some of it by AFRL/HESS, and the results have shown that significant improvements in forecasting accuracy are possible. Properly leveraging this research could result in the fielding of an improved forecasting capability in a relatively short time for a moderate investment.

4 TOOLS TO SOLVE THE PROBLEMS

It is one thing to identify problems and a list of required new logistics capabilities. It is quite another to find and recommend solutions that are available. The tools discussed in this section when used alone will contribute to improving mission support shortfalls but will appear to be the dreaded "another new system" approach that the logisticians do not want. However, when used together the tools will form the backbone of the required capabilities discussed in Section 3, Required Capabilities for Reachback. The tools discussed in this section are organized into these main areas:

- Reliable Logistics Communications
- Asset Tracking
- Total Asset Visibility
- Serial Number Tracking
- Cougaar Technology

4.1 Reliable Logistics Communications

The Air Force Portal may be of value where some communication node exists to tap into it. This could be either a hard-line communication capability or satellite connectivity. Landline communication has the obvious drawback that it may not be available at all locations, particularly at remote sites. Compounding availability limitations is that any lines available are not likely to be secure. Satellite communication is available nearly worldwide but until recently this too has had significant drawbacks—among them, size and cost of the equipment. Some tremendous progress is being made, however, with the use of such innovations as briefcase-sized communication packages.

4.1.1 Satellite Communication

One Air Force program that has embraced the new technology is the Logistician's Contingency Assessment Tools (LOGCAT) program managed by the Standard Systems Group (SSG), Logistics Planning Systems Division (SSG/ILX), Maxwell AFB-Gunter Annex, Alabama. Their implementation involves a small deployable kit that can attain a 128K connection (provided the bandwidth is available). Portable is a stretch (two nesting boxes), but if needed, the kit can be stripped to a single 64K device and a laptop (one case). This solution uses INMARSAT M4 technology and a laptop computer. The kits are ruggedized to be "gorilla" proof so all users need to do is connect the laptop, dial the number, and connect to the database. Flexibility is their hallmark. Actually two devices are connected together to get the 128K. They could be disconnected and then reconnected to the satellite with two different connections—

one data, one voice (as an example). Two laptops could also be deployed and provide two connections to the same database for multiple users. SSG selected GCS Communications for their vendor. For a baseline cost, each of the flyaway kits is reportedly about $30,000—more with various options. Use of existing laptops brings the price down. The price also includes the "gorilla" cases, engineering, cabling, etc. With experience in that sort of thing, purchasing it may not be necessary, reducing the cost even more. Additional information is contained in Appendix C: LOGCAT Satellite Communication Solution.

Inmarsat (http://www.inmarsta.com/) capable equipment is now available that ranges from the large-dish, difficult to transport equipment, to small hand-held telephones. Two commercial web sites, and there are others, describe equipment that can be used with the Inmarsat system. Their web site URLs are http://www.gmpcs-us.com/ and http://www.invsat.com/. Highlighted equipment includes telephones, video conferencing devices, and high speed data capable Inmarsat B functionality up to 64kbits/s that can be obtained in a turnkey operation or for use in conjunction with equipment currently utilized by a customer. Figure 4-1: Mobile Satellite Worldwide Coverage, depicts the normal coverage of Inmarsat as portrayed on the GMPCS web site.

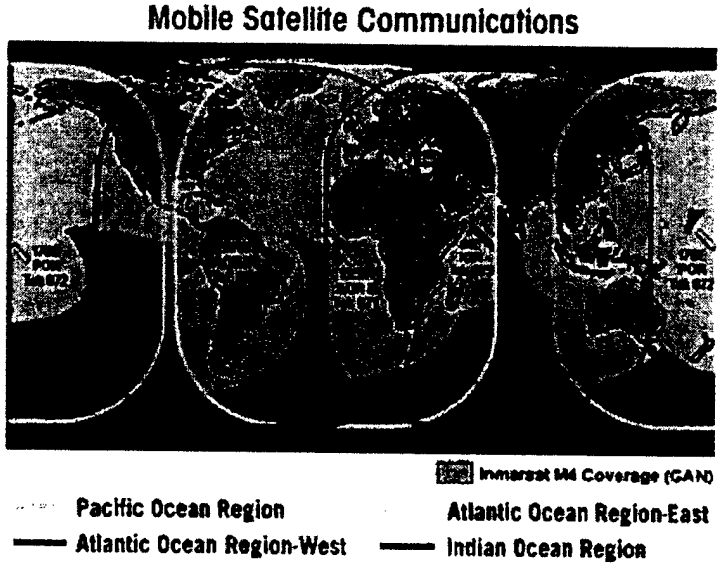


Figure 4-1: Mobile Satellite Worldwide Coverage

Currently, most of the international news broadcast corporations are using Inmarsat to provide live feeds of breaking information from remote locations to their home news locations. During Operation Desert Storm the news media demonstrated the infancy of this capability. The video was often difficult to see and the audio was clipped. The more recent news feeds of Operation Iraqi Freedom have shown the

quantum improvements made in quality of video and voice transmissions. News journalists are able to simply open their briefcase, unfold a small antenna, connect a video camera and microphone, and begin transmitting almost immediately. There is no more an hours-long equipment setup and antenna tuning requirement. The reporter does not have to "reserve a call time" with an international wire operator and companies now pay for the transmission by the megabyte transmitted, not by the minutes connected whether data is being moved or not.

This technology could allow the deployed technician to quickly establish a connection with a home-base location, discuss the problem by phone, and even send live pictures of the problem. Since system experts could be on-call from one secure location for questions from multiple hot spots around the world, the mobile satellite connectivity becomes a force multiplier. The expertise of that person or office being available worldwide with the convenience of a phone call also speeds the response to critical requirements. No longer would all requests for help have a built-in delay of hours to days due to transportation of the people and/or equipment into a remote or deployed location.

4.1.2 Wireless Communication

Information about a wearable computer provided by Xybernaut Corporation was published 28 March 2003 on the Frontline Solutions technology website. (It should be noted that some Xybernaut products are currently under evaluation by AFRL/HESR.) The computer mentioned by Frontline Solutions has built-in wireless network support, is powered by an Intel Xscale 400MHz processor, and has 128 MB of RAM standard. Its internal, rechargeable battery provides an advertised three hours of continuous use. Xybernaut's web site (http://www.xybernaut.com/) contains a number of case studies explaining the use of their device. One case study that is particularly applicable to the Air Force and deployed aircraft operations describes how Federal Express (FedEx) is using Xybernaut's Mobile Assistant® V (MA® V) as a time saver and force multiplier. Much like Air Force technicians, the FedEx employees spent considerable time traveling between aircraft work sites and other locations to obtain the expertise of other people, to get additional technical data, or to order parts. The MA® V allows the FedEx technician to call for remote assistance from any location using the computer strapped to their belt. This can be anything from a minor time-saver to the difference between an on-time mission departure and an abort. By transmitting a picture of the problem to a more experienced person, the on-scene technician can get assistance or advice to repair a problem much more quickly. With an optional viewer, the technician can view technical data, training, or a serviceable example for comparison of what may be broken on his/her aircraft. Furthermore, a cadre of experts can be available to assist with multiple on-scene work sites without having to travel from site to site for each incident. This becomes a force multiplier when multiple

airfield locations are operating simultaneously, such as with Operation Iraqi Freedom. It can be a large time saver even when operating at only one location. It takes considerable time to respond when operations are conducted at very large airfields or at new locations where dispersed aircraft operations make finding the problem aircraft difficult. Trying to find an unmarked parking location at night, in the rain, snow, or fog can be particularly vexing for someone new to the operating location.

4.2 Asset Tracking

There are three elements in tracking the location of assets. First, is the question, "Where in the local storage area is the needed item?" Second is the question, "Where in the logistics supply chain is the item that was ordered?" There is a third question that has assumed much more prominence recently, "Is the shipment secure?"

4.2.1 Local Information

One solution to the first question appears in a7 April 2003 article in Frontline Solutions. DLA has selected Psion Teklogix (http://www.psionteklogix.com/) to provide an 802.11-based wireless system for three of its Defense Distribution Centers (DDCs). The three centers stock materials including clothing, textiles, electronics, medical materials, and industrial supplies for the DoD. The system will provide workers with real-time access to inventory management and supply chain tools. Psion Teklogix 9150 wireless gateways and 9400 network controllers will provide wireless connectivity throughout the facilities. The 8560 and 8255 vehicle-mount and 7035 hand-held computers will enable depot staff to more efficiently scan, pick, and ship items. Although this solution for DLA is much larger than needed at most deployed locations, it can be scaled down to provide the same kinds of item management.

4.2.2 Assets In Transit

But, suppose an item has been ordered and is enroute. Where is it? Among the many commercial firms who have developed solutions is Savi Technology (http://www.savi.com/), which has a long history of providing shipment-tracking solutions for the DoD. In the 1990 mobilization of materiel shipped to the Persian Gulf for Operation Desert Shield, the Army shipped 40,000 containers to the Gulf, and then had to open 25,000 of them to see what was inside. The Army estimated that if an effective way of tracking the location and content of the cargo containers had existed at that time, the DoD would have saved roughly $2 billion.

In an effort to streamline its supply chain operations, the DoD awarded Savi a $70 million contract in 1994, followed by a $112 million contract in 1997 to install its Radio Frequency Identification (RFID)

hardware and software for item-level tracking in containers shipped to military installations around the world. In addition, the Defense Advanced Research Projects Agency (DARPA) has funded several Savi research initiatives to further its vision of creating the supply chain counterpart to the Internet through development of cutting-edge monitoring and optimization technologies. Today, Savi tracks more than 200,000 items, from ammunition to spare parts, for the military each year.

In 2000, the company launched their Savi SmartChain™ platform that enables end-to-end supply chain collaboration and intelligent event management; all based on accurate, real-time data from both traditional and state-of-the-art data collection technologies. Coupled with SmartChain application software, or interfaced to an enterprise resource planning (ERP) system or other enterprise software, the platform provides the foundation for any intra-enterprise or end-to-end supply chain management and security solution.

Recently, Savi launched EchoPoint™. EchoPoint is a RFID technology development platform upon which a full range of RFID products can be developed with a unique multi-frequency design and three-element system architecture to achieve both reliable long-range communication and short-range locating capability. Savi EchoPoint technology is a completely new approach to solving the challenges of real-time, automated tracking through global supply chains.

4.2.3 Shipment Security

In addition to tracking the location of material, in today's world it is vital to have secure transportation. Again, Savi Technology is in the forefront with a two-pronged effort: a Real-Time Data Collection Infrastructure and their Transportation Security System. Through prior work with the DoD and multi-national corporations, Savi has a real-time data collection network installed at over 350 locations worldwide. This expanding network ensures that cargo and inventory information is reliably collected—regardless of how it is tagged or who handles it—anywhere in the world. They use their Savi SmartSeal™ (a suite of RFID security products including the Bolt Savi SmartSeal and the Fiber-Optic Savi SmartSeal electronic security seals built on Savi's EchoPoint RFID technology) and their Savi SmartChain platform to provide scalable data collection and aggregation of all real-time and traditional data sources, including RFID, barcode, and GPS. The Savi Transportation Security System is a Web-based application that provides continuous online tracking, security monitoring, and management of cargo containers and other assets. This security solution ensures that all cargo and the contents they carry move through approved security procedures and are inspected, sealed, and accepted by authorized personnel. All security events are recorded in real time, and any deviation is immediately identified. If security problems are identified

at any time during transportation, such as tampering or breaking of a Savi SmartSeal, the system will issue an alert. The container can then be isolated for inspection and/or prevented from being loaded or moved. The Savi Security Solution works with a variety of other technologies to create a complete, secure transportation environment.

4.3 Total Asset Visibility

To address the Total Asset Visibility (TAV) issue, the DoD awarded, in February 2003, a three-year procurement contract to Savi Technology (http://www.savi.com/) for RFID hardware, and related logistics software and services. The contract is to provide automated real-time linked software to identify, locate, and track shipments. The procurement contract calls for five types of RFID technologies: Passive, Active, Beaconing, Portal-based, and Real Time Locating Systems (RTLS).

In its latest RFID procurement contract with Savi, real-time technologies can be used for both in-transit and asset-visibility operations, including inventory and warehouse environments, maintenance, repair and tracking facilities, in-transit and checkpoint transportation, hazardous materials handling, transactions at custody exchange points and controlling military convoys, among other applications. See Appendix D: Military Contract for RFID Technologies for the complete press release that describes the effort in more detail.

4.4 Serial Number Tracking

Not every asset owned by the DoD must have a unique serial number; however, many assets must be tracked at the individual identity level, i.e., test equipment, munitions handling equipment, electronic "black boxes," etc. Manufacturers already assign serial numbers to their products. These can be tracked using currently available systems if the data is manually entered into a tracking database. That is a monumental task that demands some form of automation.

The DoD Automatic Identification Technology (AIT) Office (http://www.dodait.com/) has initiated many efforts to develop standardized data gathering and reporting. Their Concept of Operations (CONOPS) states:

> AIT enables and facilitates data collection and transmission to automated information systems (AISs). AIT can improve DoD's logistics business processes and enhance warfighting capability by facilitating the collection of initial source data, reducing processing times, and improving data accuracy. The use of AIT is a key component in DoD's efforts to provide timely visibility of all logistics assets, whether in-process (being procured or repaired), in-storage (being stored as inventory), or in-transit (being shipped to another location). The operational basis for the CONOPS is a set of data timeliness criteria, or targets, for DoD's logistics system. Whenever a logistics asset leaves a commercial or military shipping activity, or arrives at a commercial or military receiving

activity, the AISs at those activities need to be capable of capturing the associated departure or receipt information and then providing that information to logistics decision-makers and customers throughout DoD.

The Air Force AIT Program Management Office is the focal point for implementing much of the DoD AIT guidance. Their web site, http://www.afmc-pub.wpafb.af.mil/HQ-AFMC/LG/LSO/LOA/, has a wealth of information about developing programs and applications (tools). Topics at their Available Applications page include life support, ammunition, clothing, asset tracking, cargo movement, tool accountability, and many others. Unfortunately, most of these systems remain stand-alone, stovepipe operations. If the multiple systems cannot be combined into a single tracking system, then an agent-based technology such as Cougaar (discussed below) would be an invaluable tool for individuals who need the information, but should not expect to remain constantly connected to multiple data systems.

4.5 Cougaar Technology

Cougaar is an acronym for "Cognitive Agent Architecture." It is a government developed Java-based architecture for the construction of large-scale, distributed, intelligent agent-based applications. Cougaar began in 1996 in The Advanced Logistics Project (ALP), which was a DARPA funded project to model military logistics using distributed agent technologies. In 2001 ALP transitioned to a new DARPA project, Ultra*Log (http://www.ultralog.net), to enhance the scalability, security, and survivability of the underlying agent environment.

4.5.1 Cougaar Background

As the underlying architecture of Ultra*Log, Cougaar contains most of the logistics domain code. In addition, in ALP and Ultra*Log it was shown to be capable of gathering data from widely dispersed sources and pulling it together to provide actionable information for decision makers. That fact makes it uniquely suitable for logistics decision support applications such as Reachback. In short, Cougaar technology has already been shown to be viable and it has potential to achieve order of magnitude improvement in decision support capability.

This research produced a Limited Concept Demonstration (LCD) that clearly shows Cougaar's ability to provide logistics decision makers major improvements in capability. The next logical step is to develop an enhanced technology demonstration, with system interfaces, more robust functionality, and enhanced user interfaces, which is capable of being applied in a field test of a Reachback environment.

4.5.2 What is Cougaar?

Cougaar is open source software with an architecture for the construction of large-scale distributed agent-based applications. Cougaar defines an agent as a software entity that autonomously communicates with other software agents to achieve domain-specific functionality. Multiple agents often collaborate as peers in a peer-to-peer distributed network. The complexity of each agent can range from simple embedded sensors to a highly complex artificial intelligence application. Cougaar is a framework for developing distributed multi-agent applications. The architecture includes components to support agent-to-agent messaging, naming, mobility, blackboards, external UIs, and additional (pluggable) capabilities. Developers write components, also called "plugins", which are loaded into agents to define or control their behavior. The Cougaar Component Model allows the developer to configure Cougaar to match both their domain and system requirements or constraints.

Cougaar is a highly configurable architecture with many capabilities. Among its unique characteristics, The Cougaar Component Model allows a Cougaar agent to be tailored from minimal single-host embedded applications to highly distributed heavyweight applications. The service-based framework allows developers to add new components without altering the architecture application program interfaces (APIs).

Cougaar is a stable architecture that is currently on Version 10.0. The architecture is built with scalability in mind. Under the Ultra*Log project, Cougaar agent societies of over 200 agents running on 30 machines have coordinated to develop complex military logistics plans in a fraction of the time required using traditional methods.

4.5.3 Why Cougaar?

This research clearly showed that logistics decision makers do not want yet another system, but they do want a capability that will work with the data systems already available, analyze that data for relationships, and present to the user alerts to indicate some action is required, list possible solutions, and perhaps inform the user that some automated response has been made to a conflict. Much like a mechanic who frequently has two wrenches at a job site, one of which is too small and the other that is too large, many of today's data systems either do not quite fit the job, or they are too large and cumbersome to use. Cougaar is an almost infinitely adjustable environment that can tie together existing data systems and add the information that can be obtained from new tools (systems) into a streamlined decision support system.

By linking many systems together and using the robust agent technology for background operation, users will have available to them all the information they need when they need it.

There are two main Cougaar web sites that offer much more detail than can be presented here. A general information site (http://www.Cougaarsoftware.com) provides the reader an excellent summary of Cougaar and how it can be used. Those individuals interested in a more in-depth discussion of how Cougaar works and how to implement it should refer to the technical web site http://www.Cougaar.org which has links to the open source software, the Architecture Design Document, and a Plugin Development Guidance document.

5 LIMITED CONCEPT DEMONSTRATION

The culmination of this research effort was the development of a Limited Concept Demonstration (LCD). The purpose of the LCD is to demonstrate the viability of the Reachback concept to the Air Force mission as well as its technical feasibility regarding use of state of the art technology. The technology selected by AFRL/HESS as the basis for the LCD was the DARPA developed Cougaar agent technology briefly discussed in Section 4.5 of this report.

The focus of the LCD was to show how a Reachback environment might be facilitated by Cougaar and, in so doing, how at least some of the requirements identified by the research as necessary for a viable Reachback environment might be addressed.

The LCD begins by showing the Cougaar generated sourcing of supply assets (the data included in the LCD is limited to F-15 APG-70 radar LRUs) that would be necessary to support a deployed unit's mission based on planned sortie rates.

The person showing the LCD can click on the individual line items and see what, if any, sub-taskings were generated to support that requirement. The information provided shows when items predicted to be required would be delivered and the Cougaar generated tasks to make that happen. Because the LCD is based on a time-phased plan, as would be the case in a real world deployment, an Event Generator is included for demonstration purposes only (see Figure 5-1: Event Generator). The Event Generator enables the person running the LCD to define a phase of operations and inject this detail into the Cougaar environment for planning purposes.

The LCD contains a set of screens to show how support of APG-70 radar transmitter requirements might be identified and supported. It starts with a requisition being submitted from an operational unit, including the discrepancy that generated the requisition. Based on that requisition, any parts known to be defective plus any parts that always require replacement when a radar transmitter goes back for repair are automatically identified and sourced.

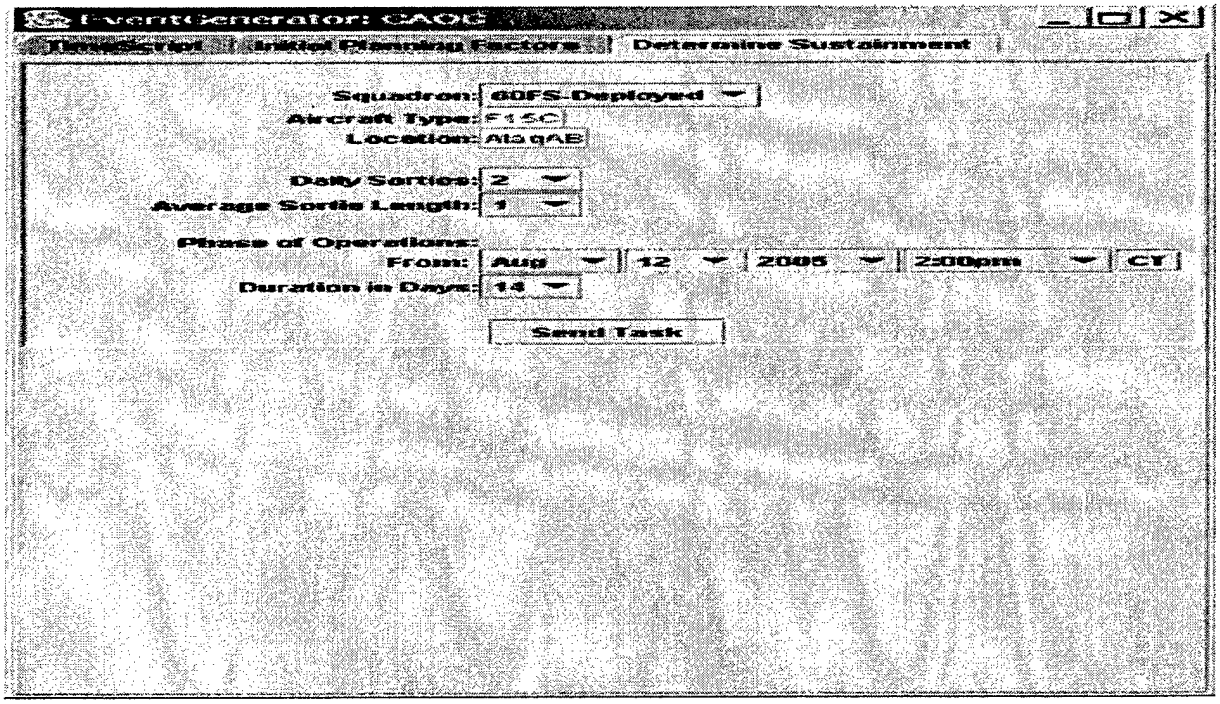


Figure 5-1: Event Generator

The LCD demonstrator can also show the Cougaar generated tasks that culminate in a serviceable radar transmitter to satisfy the requisition (see Figure 5-2: Requisition Manager). This lets the requestor, such as a production superintendent who might have ordered the radar transmitter, know when the replacement asset will be available.

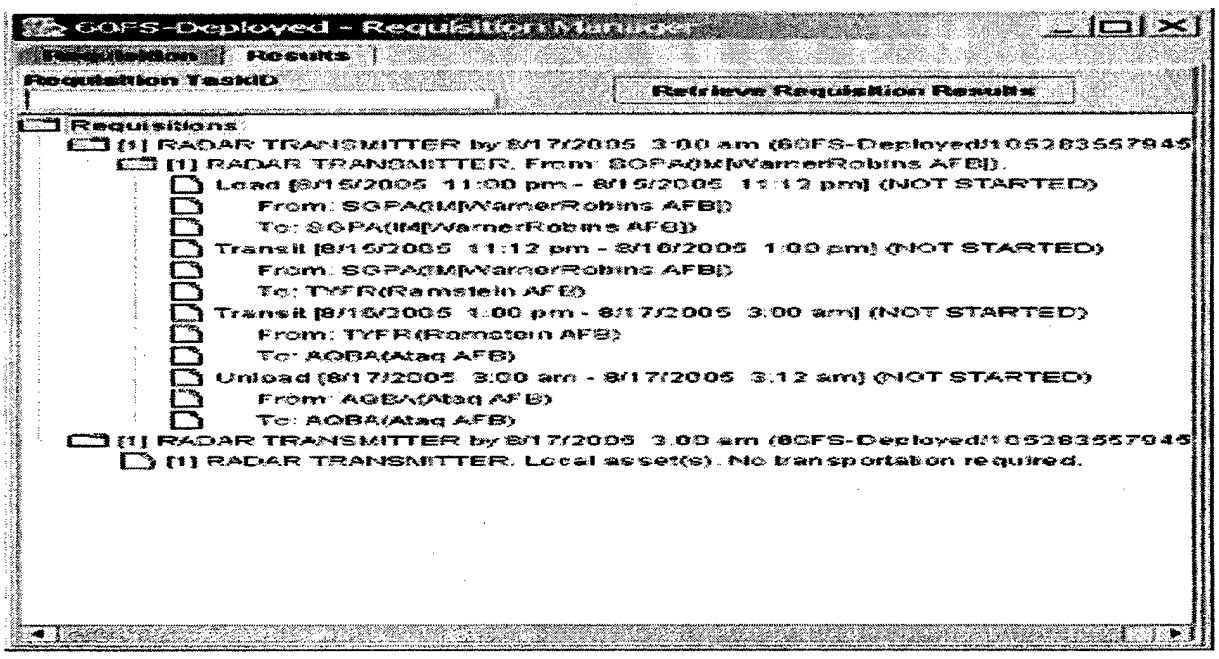


Figure 5-2: Requisition Manager

Although not shown in the LCD, it could also show that a replacement radar transmitter would not be available. In either case, the production superintendent knows in near real time what the support posture is within seconds, rather than days as is often the case today, so that solid decisions can be made to maximize mission effectiveness.

At the same time Cougaar is providing the requestor information on how the requisition will be satisfied, it is advising the repair shop manager at the Avionics Production Division at WR-ALC that a reparable radar transmitter will be coming back for repair. The Repair Manager screen in the LCD (see Figure 5-3: Repair Manager) shows where the item is coming from (in this case, the 60th Fighter Squadron—deployed) and when it will arrive at the shop. In addition, it shows the known repair parts necessary to repair the transmitter, when those items will be available to support repair of the radar transmitter, and the schedule of tasks to perform the repair.

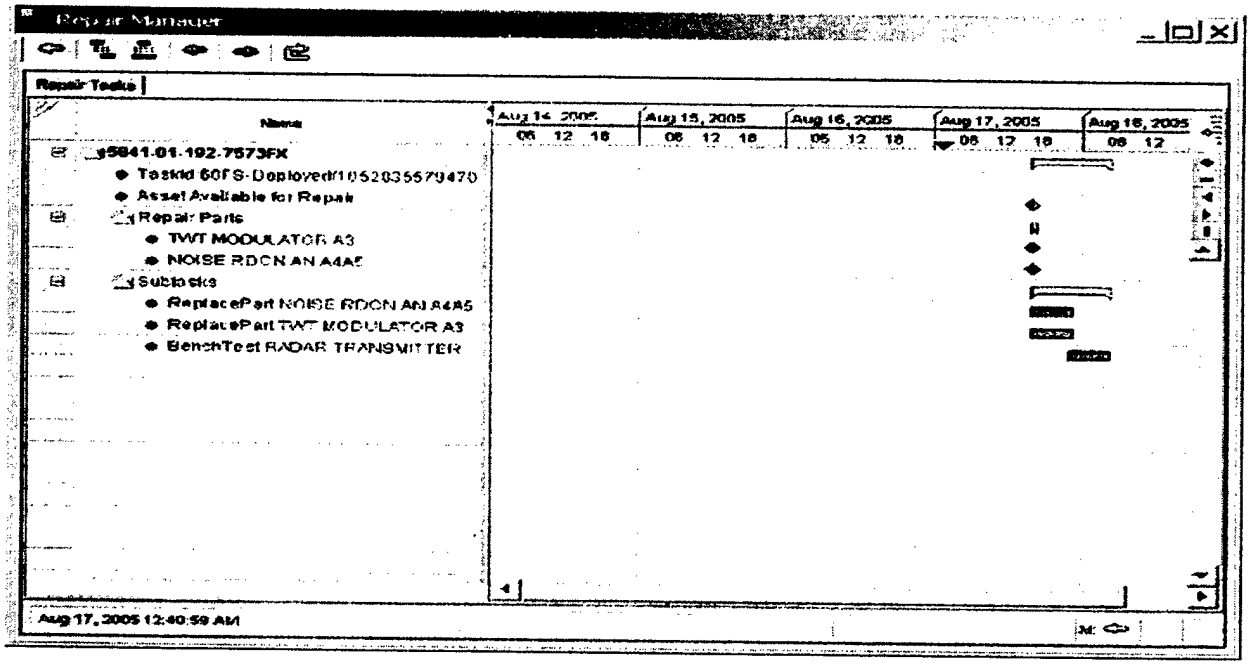


Figure 5-3: Repair Manager

The LCD includes a conceptual application called "IM Assistant" that could be made available to an Item Manager. The "IM Assistant" application would be in constant communication with applicable distributed agents and would provide enhanced decision support capability necessary to pro-actively identify and satisfy warfighter requirements, and do so much more quickly and reliably than is possible today.

The "IM Assistant" Setup Tab displays the screens necessary for the IM to perform initial setup (see Figure 5-4: IM Assistant Setup). It also shows a set of links to the systems from which data might be drawn to enable the IM to quickly go directly to the source systems if desired.

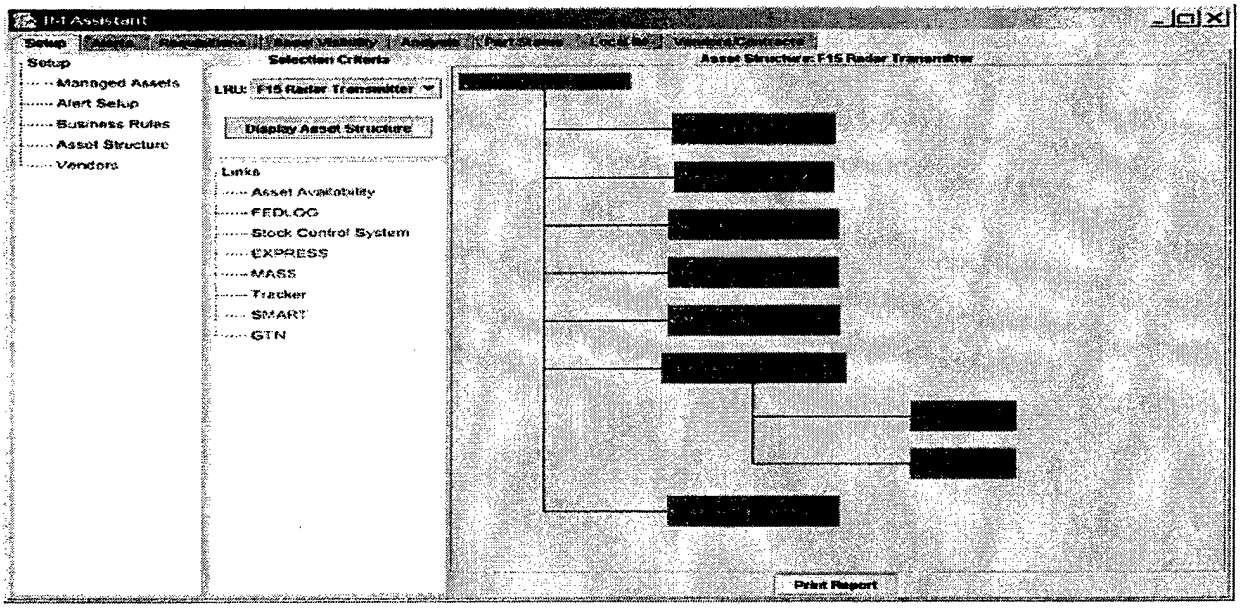


Figure 5-4: IM Assistant Setup

The Alerts Tab displays various alerts to notify the IM, based on criteria set by that IM, of conditions that might require some priority or attention. Some examples are notification of MICAP requirements that are not presently supportable, retrograde assets that are not moving as required, and critical contracts that are nearing expiration. Today, IMs must either request or go look for much of this type information.

A Requisitions Tab displays various information on open requisitions for the item in question; in this case, as in all the examples in the LCD, it is for the F-15 APG-70 radar transmitter. Information in this tab, like all others, would be presented based on criteria set up by the individual user, in this case, the APG-70 radar transmitter IM.

An Asset Visibility Tab shows the total Air Force inventory of F-15 APG-70 radar transmitters (see Figure 5-5: Asset Visibility), where each is located (including installed in an aircraft), and its status.

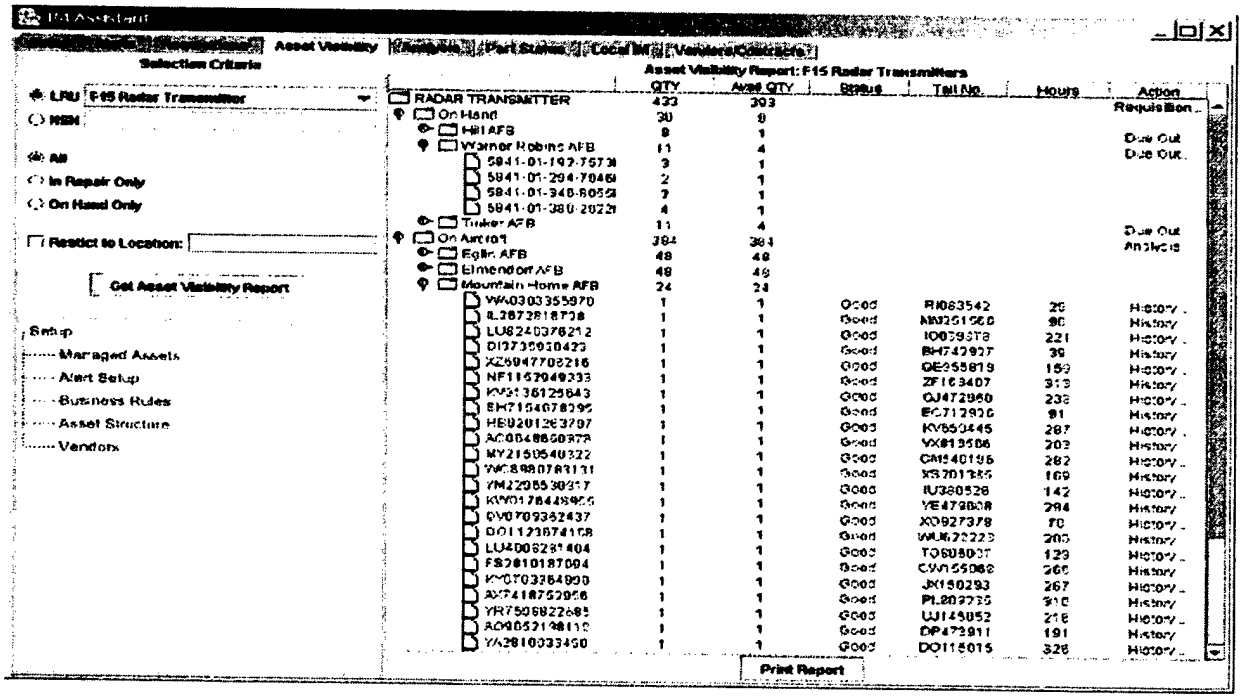


Figure 5-5: Asset Visibility

The "IM Assistant" also includes an Analysis Tab (see Figure 5-6: Analysis Tab). The IM can use this functionality to determine his/her situational readiness to support projected customer needs. He/she can also drill into alert conditions indicating potential shortfalls.

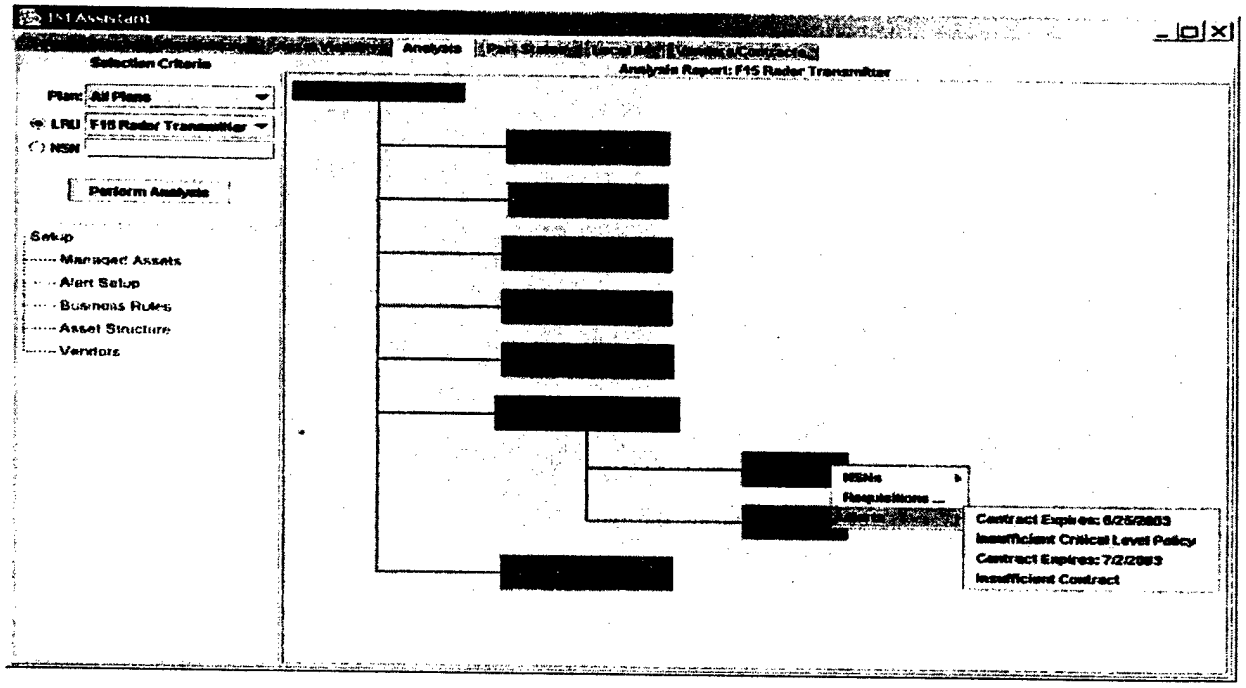


Figure 5-6: Analysis Tab

The IM can drill into repair details and schedules for specific assets using the Part Status Tab. Here the IM quickly access a variety of information related to the repair status of an LRU. Current information on such things as available/unavailable components is available here and drill down is available to specific requisitions, and to global asset visibility.

The Local IM Tab (see Figure 5-7: Local IM) enables the IM to monitor ongoing support posture for his/her managed items. The display includes graphics indicating current and past inventory levels plus desired (or critical) levels, as well as anticipated activity. Thus, an IM can see at a glance what the support posture looks like in real time. The IM can also set the system to provide alerts when certain conditions are reached or exceeded.

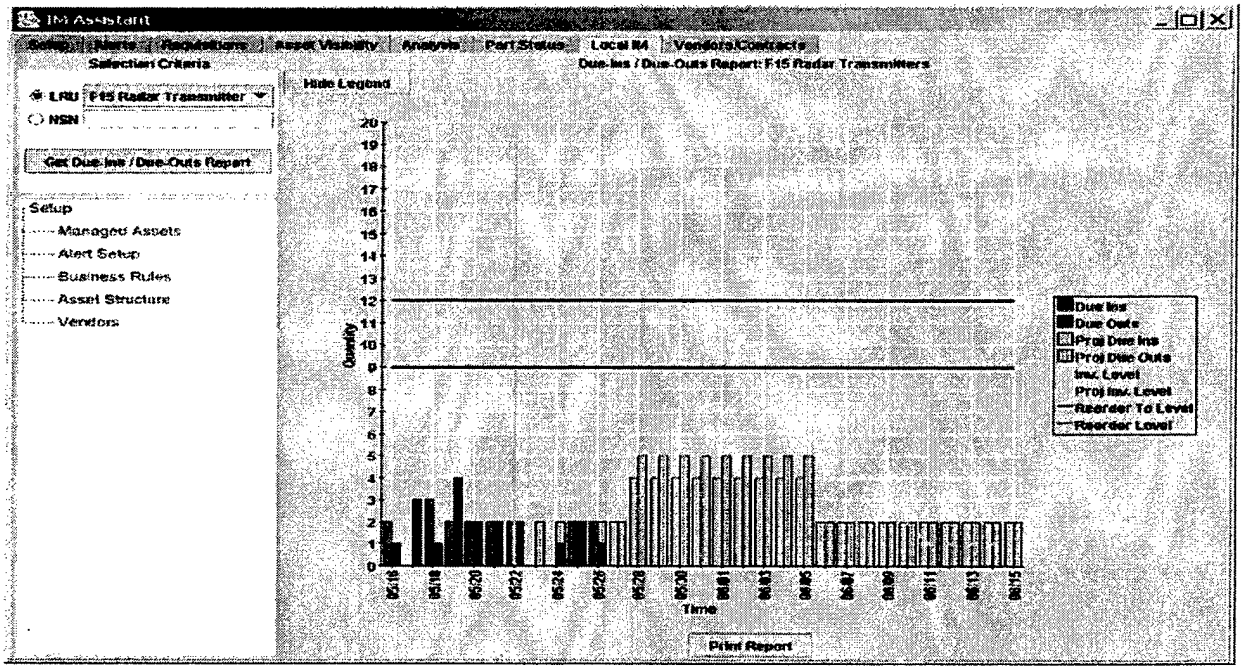


Figure 5-7: Local IM

The Vendors/Contracts Tab presents data on vendor companies. It shows information on the contracts those companies hold and the items they provide.

Using this LCD one can quite effectively provide a limited view of a concept upon which further research and development could be performed leading to a functioning, Cougaar-enabled technology demonstrator. This would be a major step toward putting in place the decision support that is essential to achieving the Reachback capability that will be essential to effective warfighter support in the coming years.

Appendix A: Glossary of Acronyms and Terms

ACC	Air Combat Command
ACS	Agile Combat Support
AEF	Air Expeditionary Force
AF	Air Force
AFB	Air Force Base
AFRL/HESS	Air Force Research Laboratory Human Effectiveness Directorate, Deployment and Sustainment Division, Sustainment Logistics Branch
AFSOC	Air Force Special Operations Command
AFTO	Air Force Technical Order
AGE	Aerospace Ground Equipment
AIDC	Automatic Identification and Data Collection
AIS	Automated Information System
AIT	Automatic Identification Technology
ALP	Advanced Logistics Project
AMC	Air Mobility Command
API	Application Program Interface
CAMS	Core Automated Maintenance System
CINC	Commander in Chief
CONOPS	Concept of Operations
CONUS	Continental United States
DARPA	Defense Advanced Research Projects Agency
DDC	Defense Distribution Center
DLA	Defense Logistics Agency
DoD	Department of Defense
DRILS	Depot Repair Information Local Server

DSCR	Defense Supply Center Richmond
ERP	Enterprise Resource Planning
FedEx	Federal Express
HQ	Headquarters
IM	Item Manager
IMSO	International Maritime Satellite Organization
INCITS	International Committee for Information Technology Standards
LCD	Limited Concept Demonstration
LOGCAT	Logistician's Contingency Assessment Tools
LRU	Line Replaceable Unit
MAJCOM	Major Command
MB	MegaByte
MICAP	Mission Capable
OC-ALC	Oklahoma City Air Logistics Center
OEF	Operation Enduring Freedom
OO-ALC	Ogden Air Logistics Center
PDA	Personal Data Assistant
RAM	Random Access Memory
RF	Radio Frequency
RFID	Radio Frequency Identification
RSS	Regional Supply Squadron
RTLS	Real Time Locating System
SBSS	Standard Base Supply System
SIPRNET	Secure Internet Protocol Router Network
SRU	Shop Replaceable Unit
SSG/ILX	Standard Systems Group, Logistics Planning Systems Division

SST	**Smart and Secure Tradelanes**
STEP	**Survey Tool for Employment Planning**
TAV	**Total Asset Visibility**
UDAP	**Universal Data Appliance Protocol**
USAF	**United States Air Force**
WR-ALC	**Warner Robins Air Logistics Center**

Appendix B: Logistics Reachback – Read Ahead.doc

Background

The Reachback Concept was introduced by the Air Staff in the Agile Combat Support CONOP as a framework within which deployed forces will be supported. Under Reachback, AEF units deploy quickly with only the basic logistics support for those forces to initiate operations upon arrival. Deployed units will then "reach back", primarily to the continental United States (CONUS), for the follow-on support necessary to conduct sustained operations. To support long term operations, especially combat operations, under the Reachback Concept it is essential that the requirements of deployed forces be known in near real time and that an integrated logistics capability be in place to fill them; again, in near real time. Ideally, the logistics system should know what those requirements are before they generate and have the required support in place or on the way by the time it is actually needed.

Although the autonomic logistics system for the F-35 (Joint Strike Fighter) will include considerable Reachback capability, over half the aircraft that will comprise the Air Force fifteen years hence are on the flightlines today. The technologies considered must be capable of supporting today's weapon systems as well as future ones, such as the F-35. Whatever the weapon systems being supported, for Reachback to be successful a common operating picture is necessary so that those in the logistics system, particularly decision makers, have a complete integrated view of the total requirements including full visibility of assets wherever they are (i.e., in repair at a depot, awaiting parts in a base shop, on a pallet in an airborne airlift aircraft, in a unit's deployment kit, or being manufactured or repaired in a contractor facility, etc.).

However, knowing the requirements and where the assets are to satisfy them is only part of this common operating picture. Another critical feature is an integrated view of the transportation system featuring options on how to get items where they are needed as quickly as possible. A necessary feature in this common operating picture is the capability to redirect enroute assets at any point in the transportation system. Such a common operating picture will give the warfighters information on which they can depend and will facilitate better decisions up and down the support chain.

This capability is achievable, but some formidable technological challenges still remain. Identifying what those challenges are and how they can be overcome is vital. It is equally vital that it be known early in the Reachback research effort what capabilities, systems, etc. the warfighters and their decision makers will need for Reachback to work. In addition, it is vital that it be known what capabilities, systems, etc.

must then be in place for the depots to support the warfighters under the Reachback Concept. The best way to get this kind of information is to simply ask; therefore visits were scheduled to HQ ACC, HQ AMC, HQ AFSOC and the depots.

Interview Sessions

The approach will be simple—conduct as many sessions as possible with senior logistics leaders and get their insight. Sessions will be one-on-one whenever possible since it is much easier to get solid input this way rather than in a larger group setting. The people contacted will all have considerable experience and will have already been, or soon will be, logistics leaders in flying organizations. As such, they will have a good view of what will be needed to make Reachback work.

Because the people with whom we will be meeting are extremely busy, we will make maximum effort to properly focus discussions so as not to waste time. Some of the areas in which we hope to gain input are outlined in question form here:

- What capabilities will the warfighting units and their decision-makers require from a Reachback system/environment?
- Who in a flying unit will require access to the Reachback system/environment and what would they be expected to get from it?
- What would make you want to use a Reachback system/environment?
- What intermediary commands/organizations will require access to the Reachback system/environment and what will they get from it?
- What one piece of functionality would you most want to be included in Reachback?
- What one thing would you avoid in developing a Reachback system/environment?
- What problem or shortcoming in today's logistics support structure should Reachback strive to fix?

This is by no means an inclusive list, nor was it meant to be. Likewise, the order in which these items are listed is not meant to denote any priority. These areas are merely put forward as "memory joggers" and to give the people with whom we will be talking some advance idea of what the discussions are likely to cover.

Appendix C: LOGCAT Satellite Communication Solution

GCS-7740 "Vanguard"

Secure Mobile Office and MPEG Store & Forward System

The GCS-7740 "Vanguard" is a portable MPEG store & forward and secure mobile office system designed to be used with Inmarsat. Users can capture high quality MPEG-1 and MPEG-2 video, establish a communication channel with the receive station, and then perform secure file and data transmissions via the integrated notebook computer.

System Features

· KIV-7HS ready and tested: A docking bay allows for easy insertion and removal of a KIV-7. The system can be also operated non-secure by simply mating the KIV-7 J2 and J3 cables together. · Entire system (notebook computer, modem, ISDN splitter, AC/DC power supply, battery, KIV-7 slot, and user I/O panel) is integrated and packaged into a rugged case with wheels and handle.

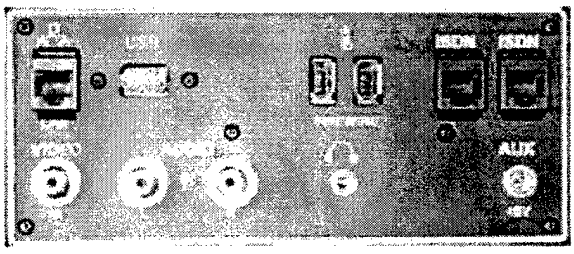
· The internal battery automatically charges whenever there is an AC or DC power source connected, and allows for up to 1.5 hours operation time when fully charged. · Integrated 'ISDN splitter' allows the use of any two Inmarsat GAN satellite phones for 128Kbps calls · Custom I/O panel makes video, audio, data, and PC connections clean and easy.

MPEG Store & Forward Features

· GCS "SoftMPEG-Pro" software creates highquality MPEG-1 & MPEG-2 files with fixed and variable encoding rates from 50Kbps to 8Mbps (MPEG-4 future option) · Both IEEE1394 "Firewire" and Composite NTSC/PAL video inputs · "ResumeFT OutStation" file-transfer protocol delivers files *quickly* and reliably to a GCS "BaseStation" receiver. Interrupted file transfers will always continue where they left off. · Simple and user-friendly software setup and operation · Transmit over dial-up (Inmarsat) or IP connections

I/O Panel Layout

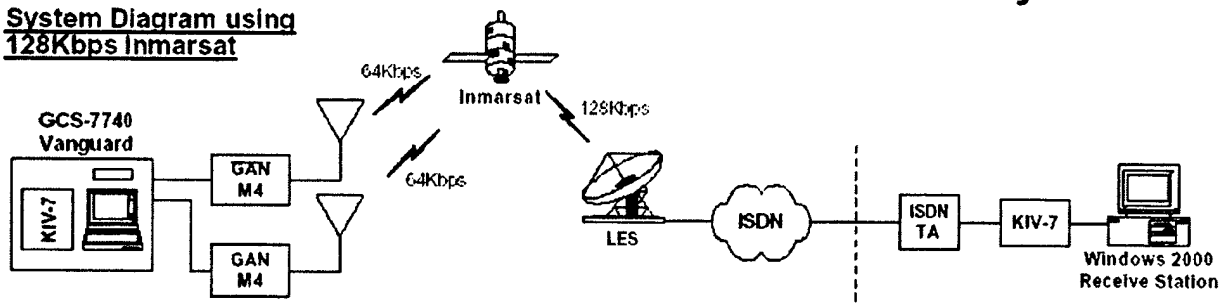
· Key interface connectors are located on a custom I/O panel located just behind the notebook computer.



GCS-7740 "Vanguard"

Secure Mobile Office and MPEG Store & Forward System

System Diagram using 128Kbps Inmarsat



Case Specifications

- Dimensions: 23.5"x20"x10.5" (60x51x26.5)cm
- Weight: 52lbs (23.5Kg)
- Power: 90-260VAC 50/60Hz, 11-16VDC

Notebook Computer Specifications

- Sony VAIO GR or GRX series (subject to change)
- PIII or P4 Processor
- DVD-ROM/CD-RW combo drive
- 30+GB HDD
- 128-256MB RAM

MPEG Compression Specifications

- MPEG-1 and MPEG-2 (256Kbps to 8Mbps)
- Fixed and variable rate encoding
- Encodes directly from IEEE1394 to MPEG
- Advanced MPEG control including motion estimation, frame intervals, filtering, etc.

Communication Interfaces

- ISDN: Two Euro-ISDN S/T RJ-45 for dual-GAN
- Serial: KIV-7 cables for encrypting the ISDN calls
- Network: 10/100Base-T LAN interface (non secure)

Video and Audio Interfaces

- Video: IEEE1394 (Firewire) and composite video input
- Audio In: IEEE1394 (Firewire) and 2-channel line-level inputs (RCA-style connectors)
- Audio Out: Headphone jack (mini stereo 1/8")

Other I/O Interfaces

- IEEE1394 Internal hub allows for two external IEEE1394 (Firewire) connections (6-pin)
- USB One or two open USB ports
- +5 Volts Auxiliary 5VDC socket

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Appendix D: MILITARY CONTRACT FOR RFID TECHNOLOGIES

U.S. Department of Defense Contract Calls for Automated
Real-Time Solutions and Inter-Linked Software
to Identify, Locate, Track and Manage Shipments

WASHINGTON, DC - Feb. 10, 2003 - Savi Technology announced today that it has been awarded a three-year procurement contract by the U.S. Department of Defense valued at up to $90 million for Radio Frequency Identification (RFID) hardware, and related logistics software and services. The award enables U.S. military personnel to procure directly through Savi a wide range of proven automatic identification and data collection technologies (AIDC) and related software to track, monitor, locate, secure, process and deploy military supplies worldwide.

This is Savi's third multi-year RFID procurement contract with DoD since 1994, for a combined total contract value of $280 million. During this time, Savi has helped to build and operate and continues to extend the DoD's Total Asset Visibility (TAV) network, already the world's largest active RFID logistics tracking system, which monitors and manages 270,000 cargo containers transporting military supplies throughout 400 locations in more than 40 countries. RFID tags along with a wide variety of AIDC technologies from bar codes to satellite systems are affixed to cargo containers and other conveyances. The real-time data that these systems automatically capture is integrated into a global software network to provide immediate information on the location and status of the containers and their contents.
Savi will be responsible, in conjunction with the Army's Product Manager for Automatic Identification Technology, in responding to military proposals for real-time solutions provided by the company and through strategic alliances with market-leading automatic identification technology providers. The procurement contract calls for five types of RFID technologies: Passive, Active, Beaconing, Portal-based, and Real Time Locating Systems (RTLS). The contract calls for three years of equipment purchases and two years of training and maintenance services.
"Only Savi can integrate active and other RFID technologies providing users with technical engineering services to field a coherent integrated solution," stated the Justification and Approval document for the contract, following an 18-month evaluation of commercial providers. "Savi has developed unique software that facilitates integration and management of all types of RFID technologies. This software is based on the Universal Data Appliance Protocol (UDAP), an interface to which many RFID suppliers are building. Users will be able to manage all Savi supplied and installed products using this integrated software solution."

"Through its continued adoption of proven RFID technologies, the U.S. Department of Defense, as one of the world's largest shippers, has built a sophisticated logistics network that truly synchronizes the flow of information with the flow of goods in real time," said Vikram Verma, Savi's CEO, who has been instrumental in the company's long-time relationship with the DoD. "The Total Asset Visibility network is the physical equivalent of the Internet, and the technologies available now because of its continued expansion also provide unparalleled management and security benefits for the commercial supply chain community."

Verma also emphasized that the DoD's selection of Savi will help to drive common global standards for RFID technologies, helping to open up this market for a wider array of applications and greater marketplace adoption. Savi's RFID tags are the only active tags on the market currently compliant with the ANSI International Committee for Information Technology Standards (INCITS) 256-2001 Standard, a minimum requirement for the DoD. The Savi-developed UDAP interface also enables interoperability between all kinds of automated data collection devices and the Savi SmartChain software platform and suite of asset management and transportation security applications.

Technology that Savi developed for the U.S. DoD now is currently driving a number of commercial projects. Most importantly, both the infrastructure and 6th-generation technology developed for the TAV network are currently being leveraged for the industry-driven Smart and Secure Tradelanes (SST) initiative. Announced in July, SST is deploying RFID technologies and inter-linked software provided by Savi and its partners to improve the security and management of ocean cargo containers shipped into U.S. seaports. Partners in SST include three of the world's largest port operators - Hutchison Port Holdings, P&O Port Holdings, and PSA Corporation.

In its latest RFID procurement contract with Savi, the DoD said the real-time technologies can be used for both in-transit and asset-visibility operations, including inventory and warehouse environments, maintenance, repair and tracking facilities, in-transit and checkpoint transportation, hazardous materials handling, transactions at custody exchange points and controlling military convoys, among other applications.

For additional information, visit www.savi.com